Operations of the NOvA Near Detector on the Surface (NDOS)

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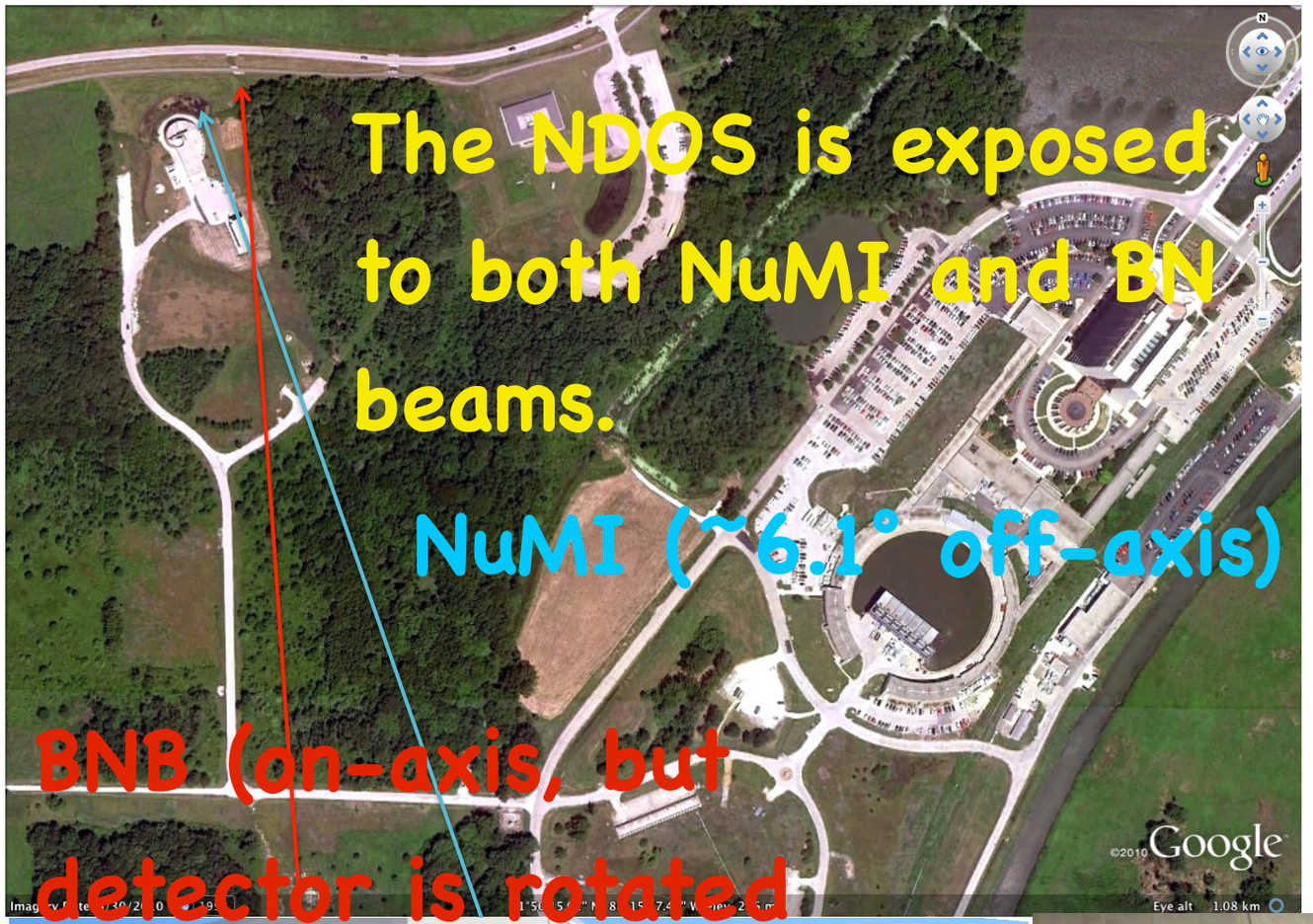
All Experimenters' Meeting

April 30, 2012

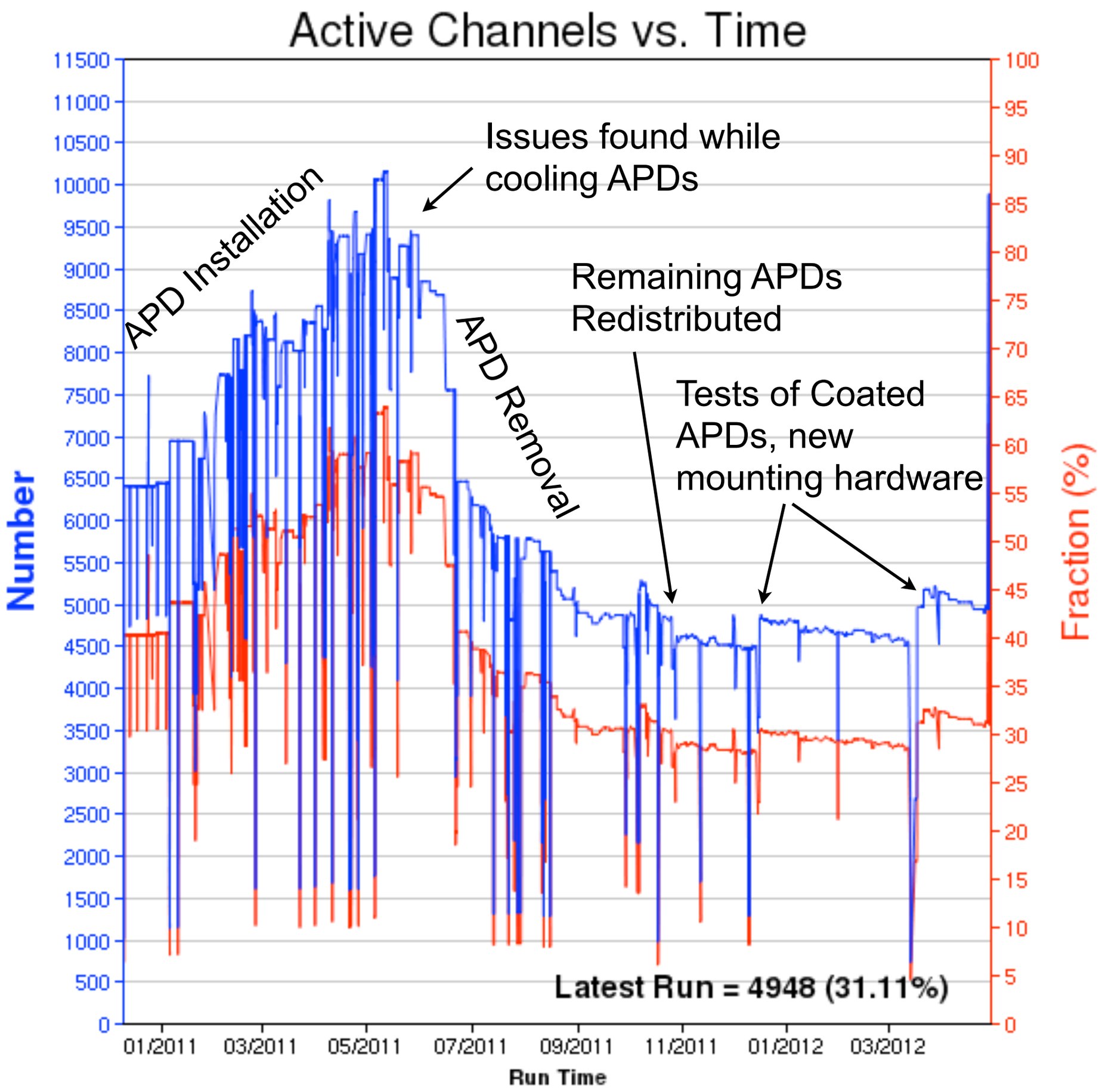
The NOvA NDOS



- 210 ton **prototype** detector.
- ~16,000 highly reflective 4 cm x 6 cm x 4(3) m PVC cells filled with liquid scintillator.
- Muon catcher at end designed to capture muons from beam neutrino interactions.
- Partially instrumented during the 2011-12 run.

The NOvA NDOS

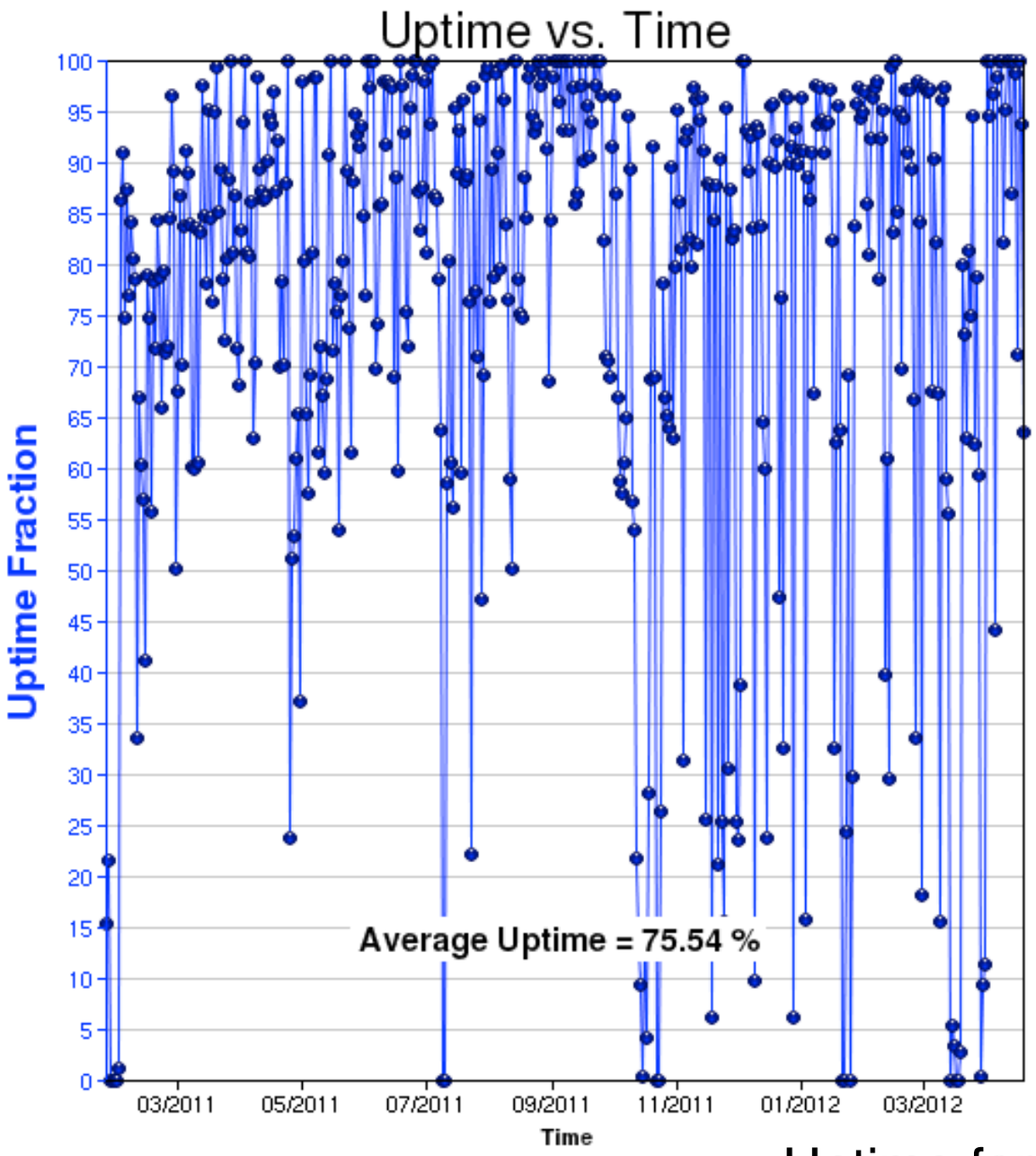
- Goals:
  - Full test of assembly and integration of all detector components
  - Light yield studies
  - Improvements of DAQ and DCS functionality and stability
- Physics opportunities:
  - Development of calibration and alignment techniques
  - Improvements to MC detector response simulations
  - Determination of cosmic-ray backgrounds
  - Measurement of CC and NC rates
  - Measurement of off-axis beam composition

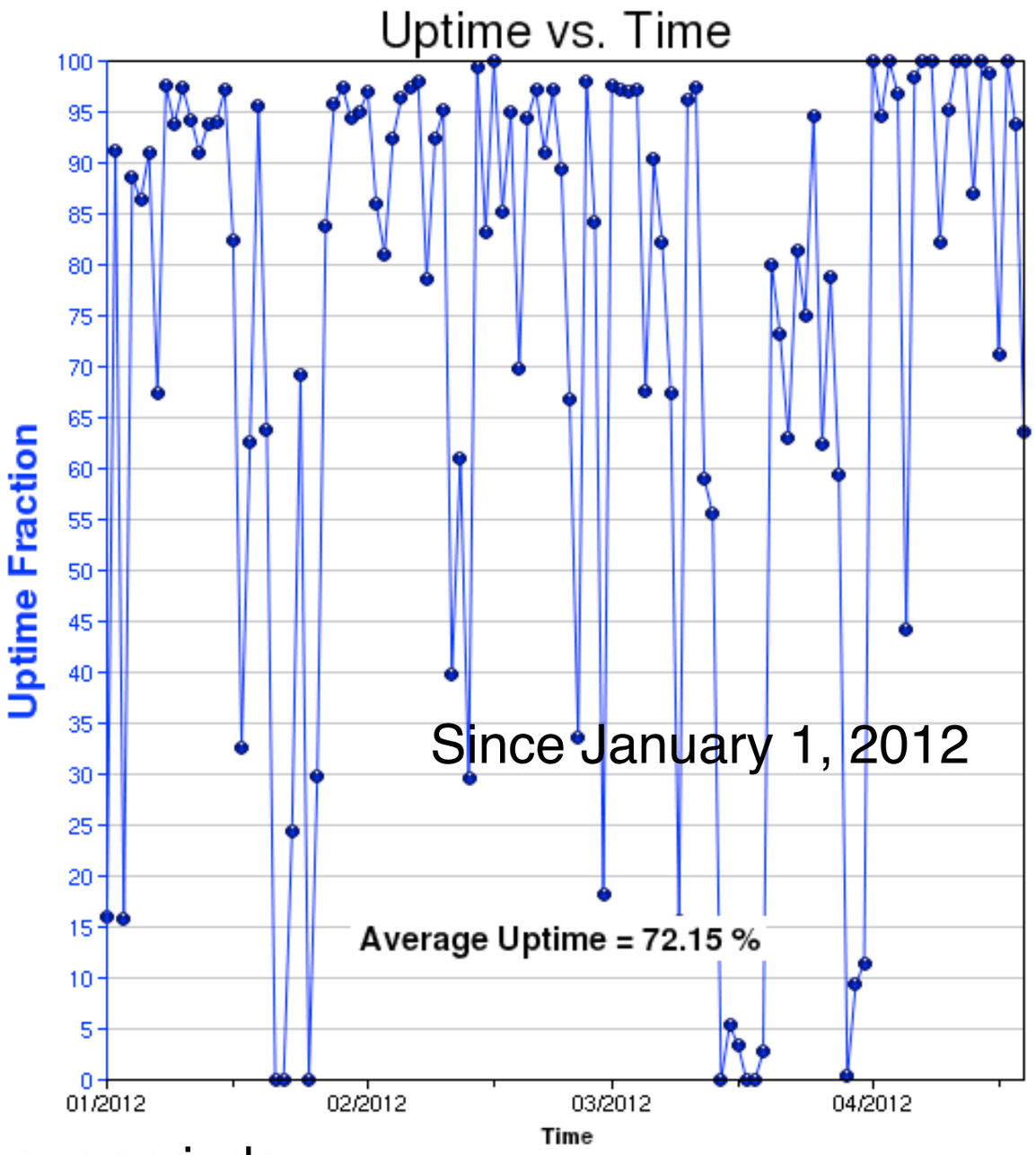

Active Channels vs. Time
Issues found while cooling APDs
APD Installation
APD Removal
Remaining APDs Redistributed
Tests of Coated APDs, new mounting hardware
Latest Run = 4948 (31.11%)
Number
Fraction (%)
Run Time
01/2011
03/2011
05/2011
07/2011
09/2011
11/2011
01/2012
03/2012

The NDOS APD Saga (or, this is why we build prototypes)

- APDs need to be cooled to -15°C to reach sufficient noise levels (at FD)
- Cooling done by active water system and thermo-electric cooler
- Photosensitive face of APD sits in desiccated, air-tight volume.
- Failure of seals led to air entering volume.
- Cooling led to formation of condensation on photosensitive surface of APD, which caused electrical shorts and scorching of surface.
- In order to guarantee more robust system, two-pronged approach now being tested:
  - Protective coating on surface of APDs (Silicone or parylene; both show ~5% drop in light)
  - active dry-air purge system of APD volume

DAQ Stability

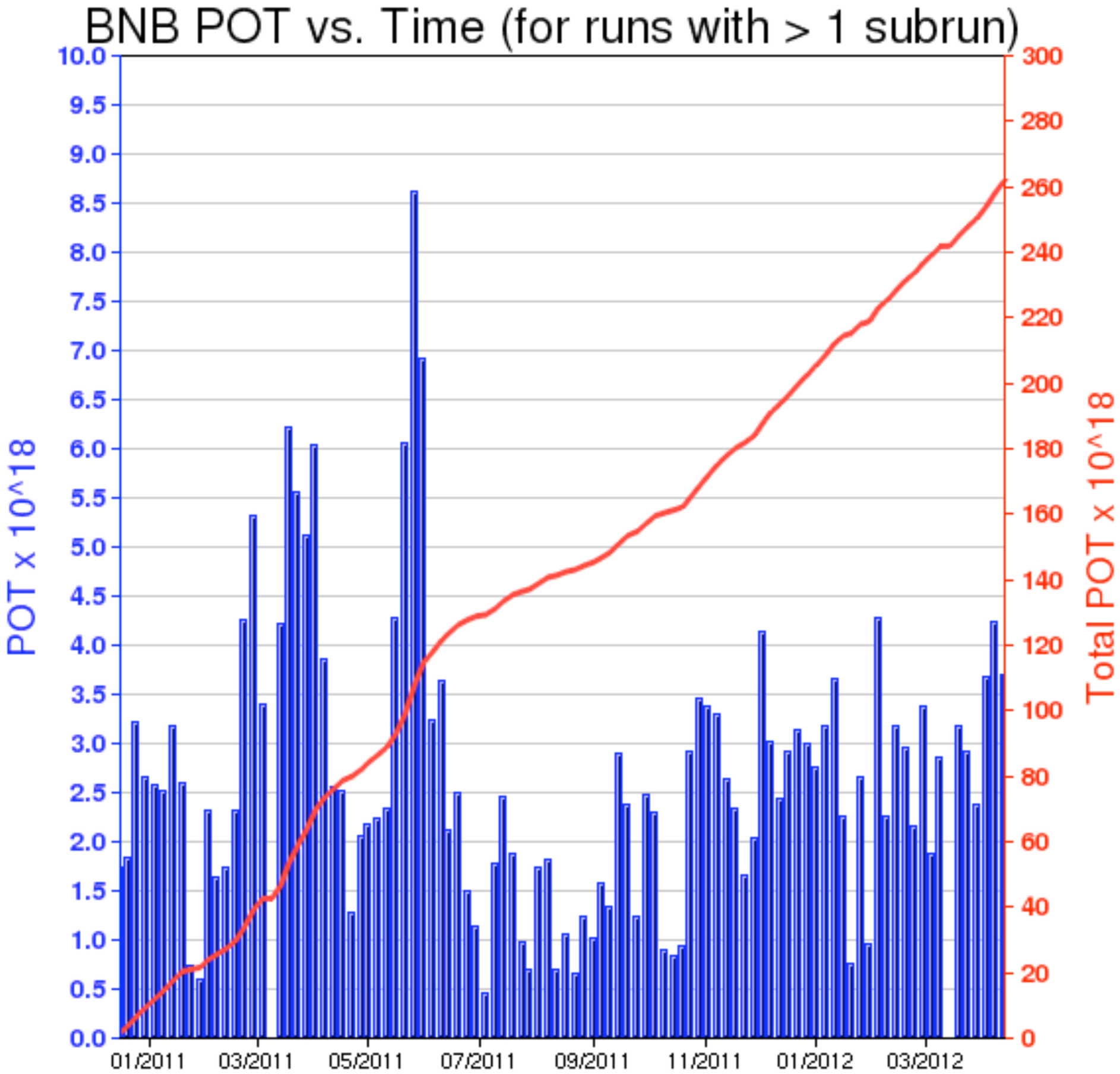




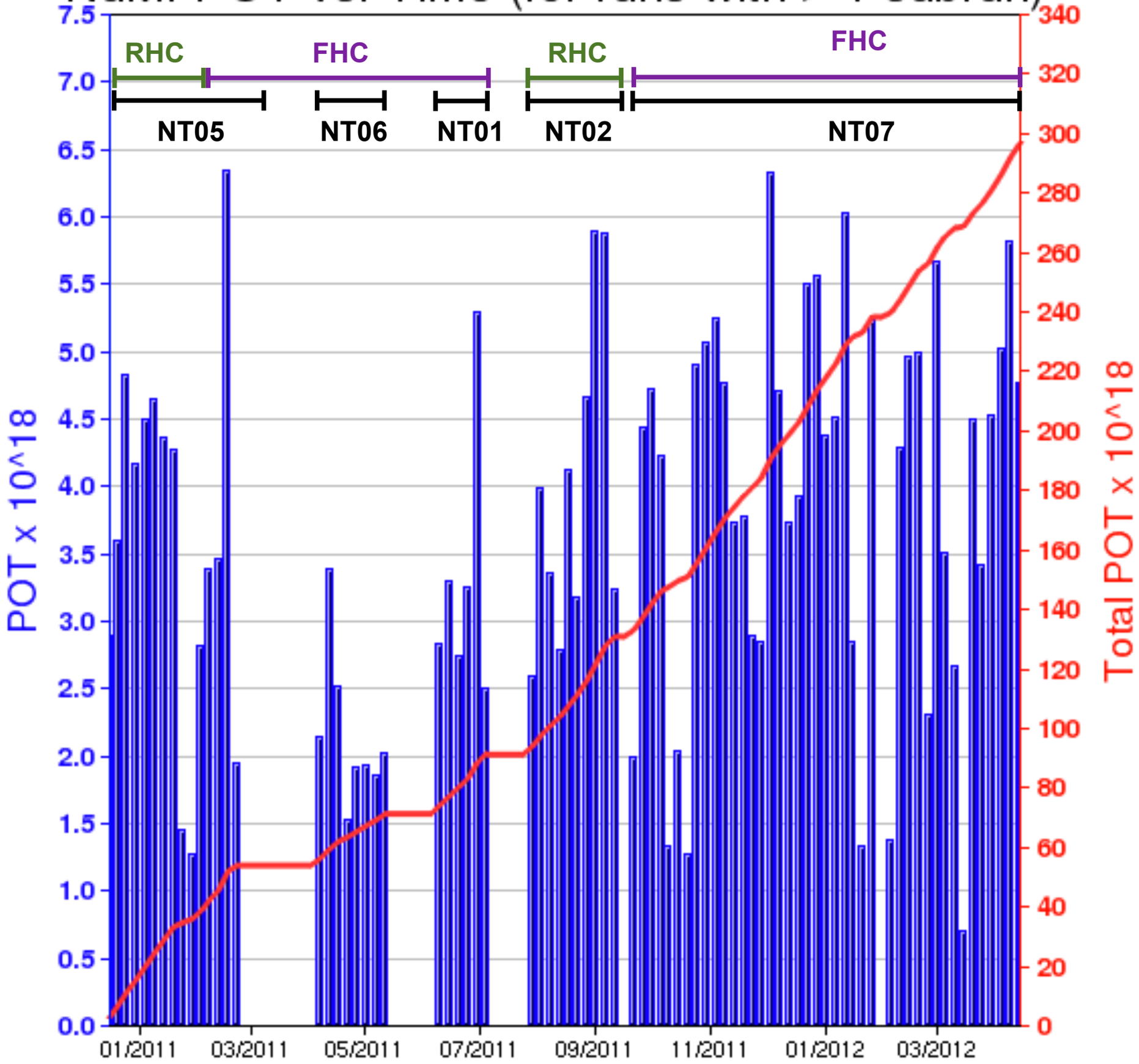
Uptime for 24 hour periods

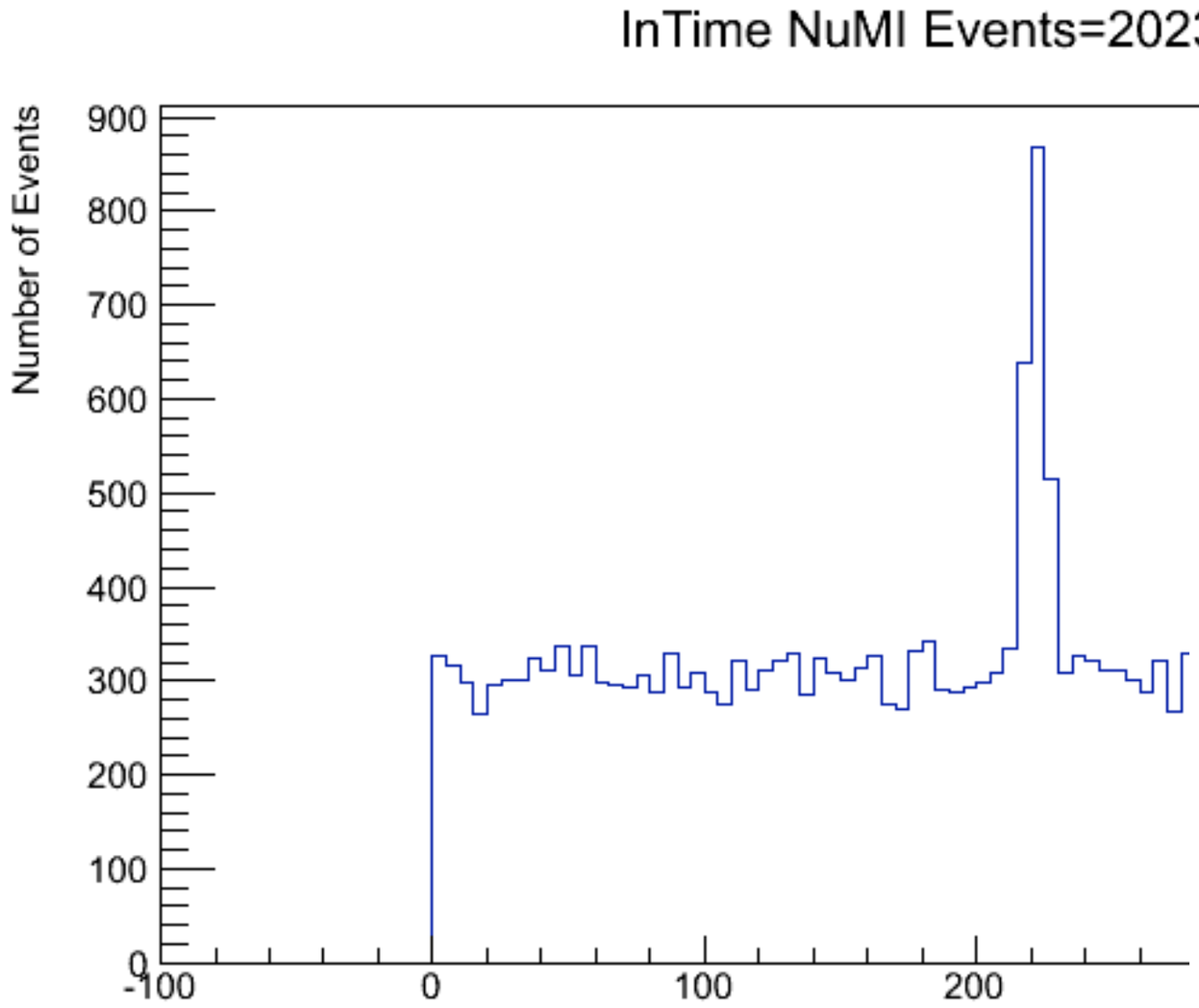
Overnight Uptime Fraction: 96.9%

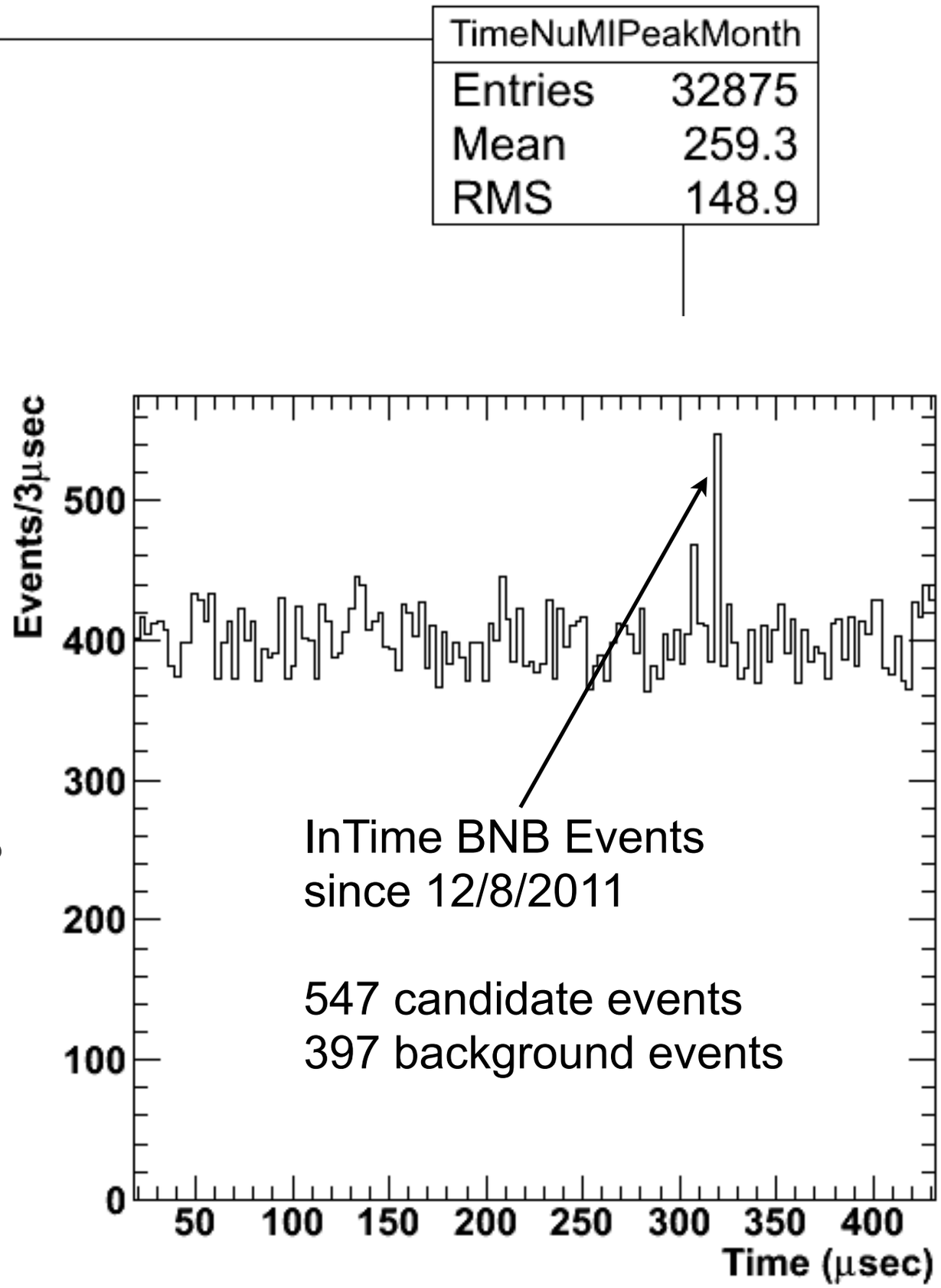
Overnight Uptime Fraction: 100%


BNB POT vs. Time (for runs with > 1 subrun)
POT x 10^18
Total POT x 10^18
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
01/2011
03/2011
05/2011
07/2011
09/2011
11/2011
01/2012
03/2012

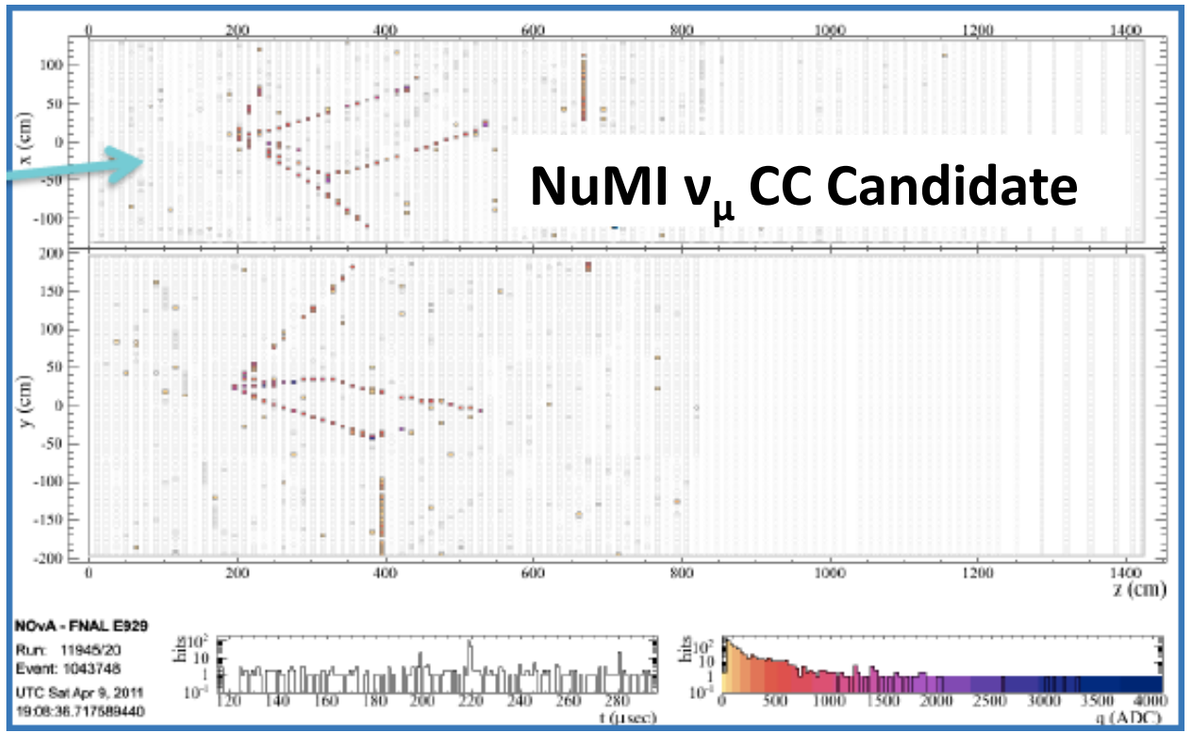
NuMI POT vs. Time (for runs with > 1 subrun)

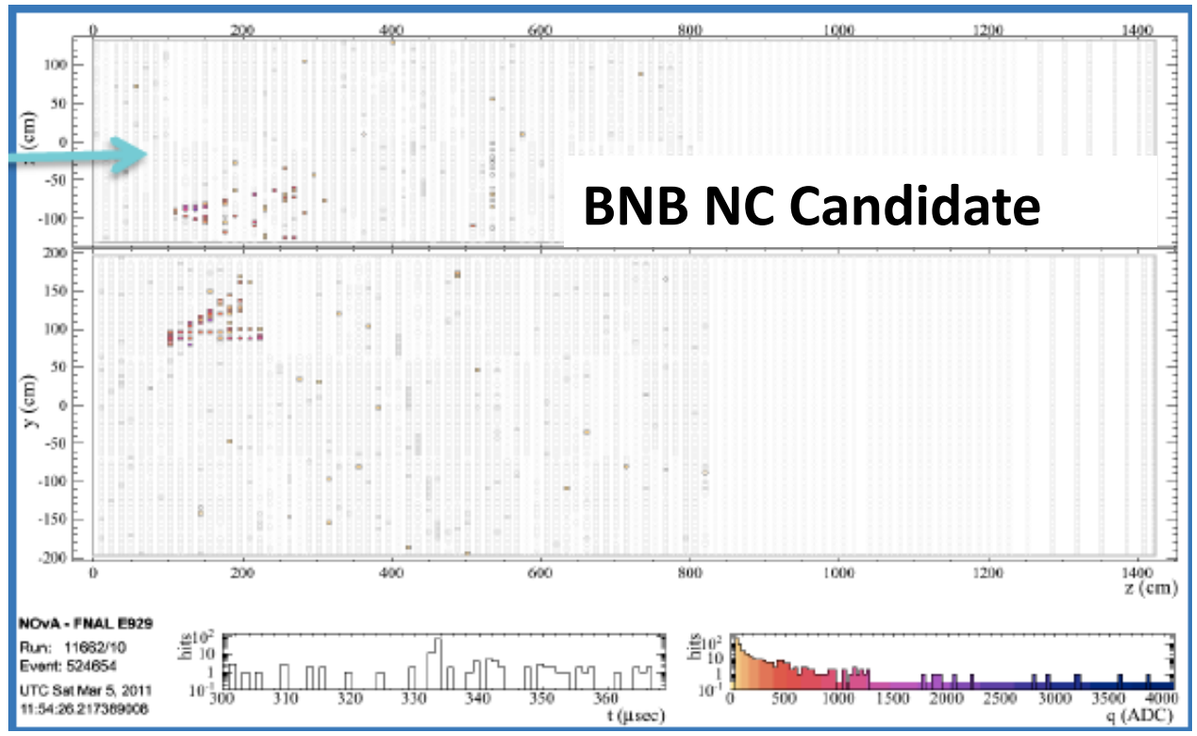


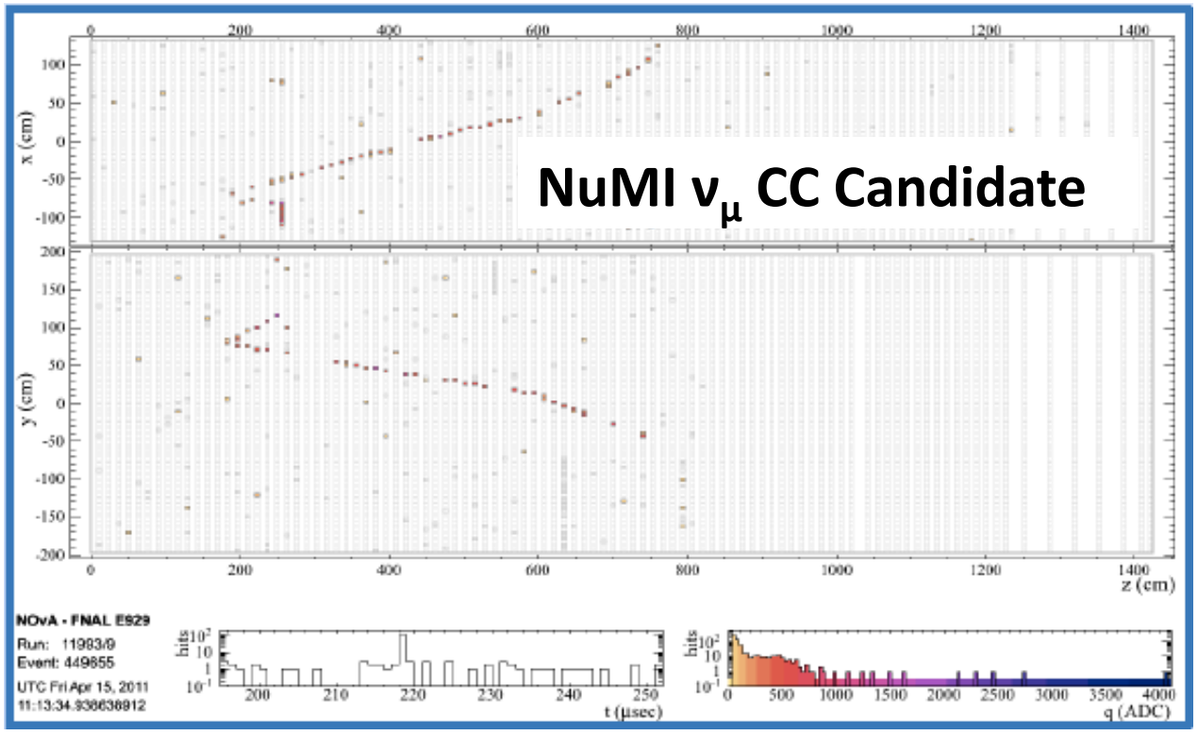


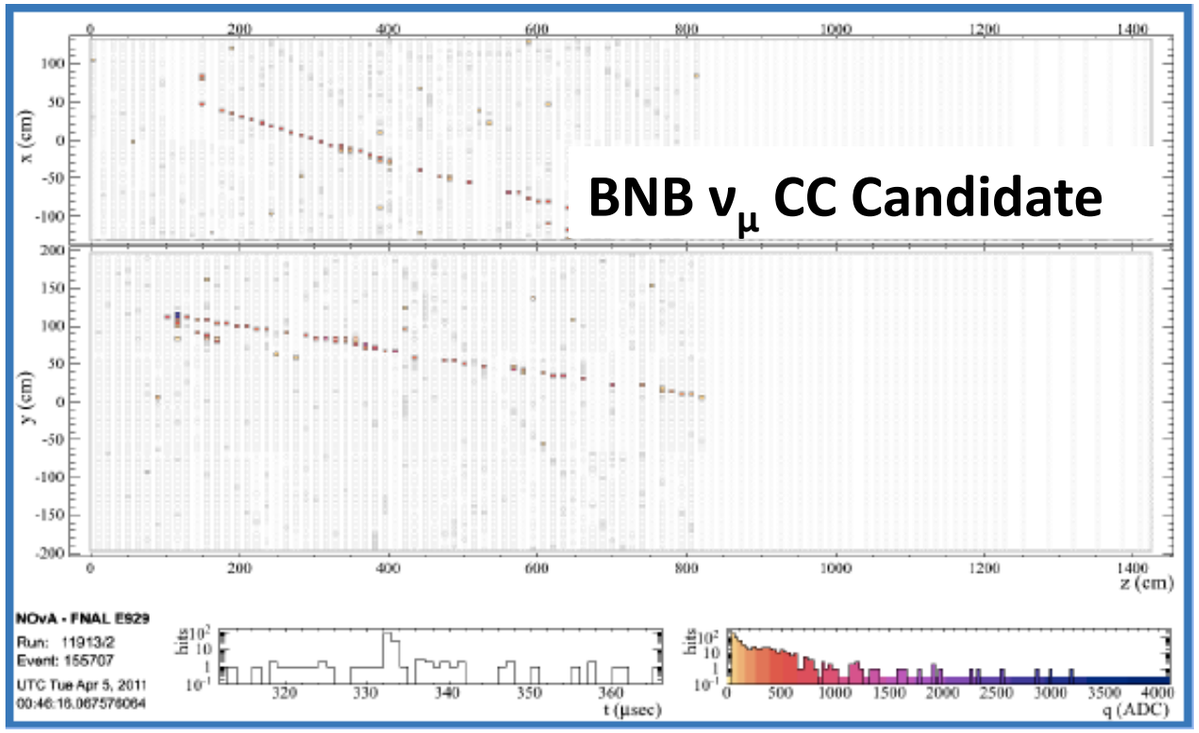


- Dedicated reconstruction and cuts optimized to find NuMI and BNB candidate events.


NuMI ν_μ CC Candidate
x (cm)
y (cm)
z (cm)
NOvA - FNAL E929
Run: 11945/20
Event: 1043748
UTC Sat Apr 9, 2011
19:08:36.717589440
bits
t (μsec)
q (ADC)


BNB NC Candidate
x (cm)
y (cm)
z (cm)
NOvA - FNAL E929
Run: 11682/10
Event: 524654
UTC Sat Mar 5, 2011
11:54:26.217389008
bits
t (μsec)
q (ADC)


NuMI ν_μ CC Candidate
x (cm)
y (cm)
z (cm)
NOvA - FNAL E929
Run: 11983/9
Event: 449855
UTC Fri Apr 15, 2011
11:13:34.938636912
bits
t (μsec)
q (ADC)


BNB ν_μ CC Candidate
x (cm)
y (cm)
z (cm)
NOvA - FNAL E929
Run: 11913/2
Event: 155707
UTC Tue Apr 5, 2011
00:46:16.067578064
bits
t (μsec)
q (ADC)

NDOS Commissioning – What Have We Learned?

- All sorts of construction and installation issues (what kept many of us up late at night): block construction and installation, manifold cracks, APD mounting + cooling challenges, APD, FEB and DCM checkout, scintillator filling, etc.
- Performance of both DAQ + DCS hardware and software, and how these scale from NDOS to FD.
- How to make DAQ and DCS systems work together (still some work to do, but huge progress). DCS uses the readout line as the DAQ system. Readout for these two systems had to be coordinated, not a trivial task!
- Much much more…

NDOS Commissioning - What Have We Accomplished?

- Created a very stable DAQ system!
- Developed file transfer, nearline, online-monitoring systems.
- Offline calibration and analysis of "difficult" data.
- Migration to new electronic logbook and shift scheduler: ECL (FNAL CD product)
- Active dry-air APD purge system designed and tested on NDOS; 12 APDs have been operating "cooled" for ~1 week.

NDOS Commissioning – What's Next?

- During shutdown (and beyond), NDOS will continue to run and collect cosmic data until NDOS is longer "needed".
- New DCMs to be installed this week; NDOS will then have a full complement of new (FD) hardware
- New APDs + mounting hardware to be installed on NDOS in this week
- Continued DAQ development, eg partitioning and automatic error recovery.
- Continued DCS development.
- **ALL** of this work is absolutely **CRITICAL** to being ready to take data in partial FD on day 1 of beam turn-on next year; active analysis of commissioning data from this summer will continue.